## Results and Discussion

### 1995 Bald Eagle Nesting Activity and Productivity

There are currently 42 known bald eagle breeding areas within the Southeast Idaho portion of the Greater Yellowstone Ecosystem (GYE). Of this total, 24 are found within the Snake Idaho Unit of the GYE population, and 18 in the Continental Idaho Unit (Whitfield et al. 1995 b). In 1995, 39 of the 42 known territories were occupied, and 29 were active. Known 1995 productivity at these sites was 1.00 advanced young per occupied nest.

This year, 1995, was a reversal of 1994 trends, with many similarities to the cold, wet spring of 1993. Lower elevation nests were generally very productive (3 young at each of 4 nests), whereas those at higher elevations were notably poor. The 10 active pairs of the South Fork Canyon (1 new pair) produced 19 young in 1995 (11 young in both 1993 and 1994), and the remainder of the lower elevation nests in the Snake Unit produced 10 young (7 in 1994). Continental Unit territories (18) produced only 10 young in 1995 (16 in 1994 at 17 territories, 8 in 1993 at 16 territories). The 5 nests found near Palisades Reservoir produced no advanced young in 1995 (7 in 1994, only 1 in 1993, 7 in 1992). Overall, poor productivity in 1993 and 1995 appears to be related to wet, cold weather during critical times for later nesting pairs. In Island Park, several eagle nests were snow-covered far into the nesting season.

In 1995, productivity monitoring was very difficult because it was hard to determine actual outcome for many sites. At most sites, we overcame this difficulty by visiting sites more often that usual. Adults were infrequently seen at several nest sites; ten non-productive sites did not initiate incubation as far as we could determine. (It appeared that adults at these sites were as perplexed by the cold spring as were the observers.) Six of 7 unsuccessful breeding areas appeared to fail early in incubation. Five pairs moved to new alternate nests. It is still possible that we missed detecting new alternate nest sites at a few breeding areas, including King Creek, Lucky Dog, Henry's Lake, and Coffee Pot, despite numerous searches.

Three new breeding areas were located in 1995: Hog Hollow (18-IS-23) on the lower Teton River, Five Ways (18-IS-24) within a portion of what was the Pine Creek breeding area (18-IS-07), and Big Bend (18-IC-18) at what was the margin of the Moonshine (18-IC-11) and Last Chance (18-IC-12) breeding areas. Hog Hollow, 18-IS-23, was discovered during an Idaho Department of Fish and Game flight over the lower Teton River. A site in this area has been suspected for several years, and has probably been active in past years. Five Ways, 18-IS-24, on the South Fork above Pine Creek, was built last season by a notably young female (dark feathers on head), with first production this year. The Big Bend adult female appears to be relatively young; her color band indicates that she was banded in 1987 or 1988 in the Snake Idaho Unit. The Big Bend nest was first built in late summer, 1994, in a year when the nearby Moonshine nest produced one fledgling.

This year we observed 5 nesting adults that were banded as nestlings in the GYE, and determined the natal nest of 3 of these adults. Band checks revealed nine adults that were definitely not banded. In 1995, 13 Idaho/GYE nestlings were banded with numbered FWS leg bands on the right leg and color bands with two digit alphanumeric codes on the left leg.

**Table 3. Activity and productivity status for bald eagle breeding territories within the Idaho portion of the Greater Yellowstone Ecosystem, 1995.**

| TERRITORY NAME | TERRITORY NUMBER | PRODUCTIVITY STATUS | NUMBER ADVANCED YOUNG | NUMBER YOUNG BANDED | COMMENTS |
|---|---|---|---|---|---|
| PALISADES RESERVOIR AREA | | | | | |
| Hoffman | 18-IS-01 | Occupied, Inactive | 0 | 0 | |
| Williams Creek | 18-IS-02 | Active, Unsuccessful | 0 | 0 | |
| Van Point | 18-IS-03 | Active, Unsuccessful | 0 | 0 | |
| Edwards Creek | 18-IS-17 | Occupied, Inactive | 0 | 0 | |
| King Creek | 18-IS-18 | Unoccupied | 0 | 0 | |
| SOUTH FORK SNAKE RIVER | | | | | |
| Palisades Creek | 18-IS-04 | Active, Successful | 2 | 2 | |
| Swan Valley | 18-IS-05 | Active, Successful | 3 | 0 | |
| Conant Valley | 18-IS-06 | Active, Successful | 3 | 3 | |
| Pine Creek | 18-IS-07 | Active, Unsuccessful | 0 | 0 | New alternate nest |
| Dry Canyon | 18-IS-08 | Active, Successful | 2 | 0 | |
| Gormer Canyon | 18-IS-09 | Active, Successful | 2 | 2 | |
| Wolverine | 18-IS-10 | Active, Successful | 1 | 1 | |
| Antelope Creek | 18-IS-11 | Active, Successful | 2 | 0 | New alternate nest |
| Cress Creek | 18-IS-12 | Active, Successful | 3 | 0 | New alternate nest |
| Five Ways | 18-IS-24 | Active, Successful | 1 | 0 | New territory |
| MAIN SNAKE RIVER | | | | | |
| Confluence | 18-IS-13 | Active, Unsuccessful | 0 | 0 | |
| Market Lake | 18-IS-22 | Active, Successful | 1 | 0 | |
| LOWER SOUTH FORK, HENRY'S FORK, FALL RIVER | | | | | |
| Menan Buttes | 18-IS-20 | Active, Successful | 2 | 0 | |
| Cartier Slough | 18-IS-14 | Active, Unsuccessful | 0 | 0 | |
| St. Anthony | 18-IS-15 | Active, Successful | 1 | 0 | |
| Singleton | 18-IS-16 | Active, Successful | 2 | 0 | |
| Lower Fall River | 18-IS-19 | Occupied, Inactive | 0 | 0 | |

**Table 3. Activity and productivity status for bald eagle breeding territories within the Idaho portion of the Greater Yellowstone Ecosystem, 1995 (cont.).**

| TERRITORY NAME | TERRITORY NUMBER | PRODUCTIVITY STATUS | NUMBER ADVANCED YOUNG | NUMBER YOUNG BANDED | COMMENTS |
|---|---|---|---|---|---|
| TETON RIVER, SNAKE UNIT | | | | | |
| Upper Teton | 18-IS-21 | Active, Successful | 1 | 0 | New alternate nest |
| Hog Hollow | 18-IS-23 | Active, Successful | 3 | 0 | New territory |
| CONTINENTAL UNIT, UPPER HENRY'S FORK SNAKE RIVER | | | | | |
| Kerr Canyon | 18-IC-01 | Active, Successful | 2 | 2 | |
| Pine Haven | 18-IC-02 | Occupied, Inactive | 0 | 0 | |
| Box Canyon | 18-IC-03 | Active, Unsuccessful | 0 | 0 | |
| Coffee Pot | 18-IC-04 | Occupied, Inactive | 0 | 0 | |
| Bishop Lake | 18-IC-05 | Occupied, Inactive | 0 | 0 | |
| Sheridan | 18-IC-06 | Occupied, Inactive | 0 | 0 | |
| Lucky Dog | 18-IC-07 | Occupied, Inactive | 0 | 0 | |
| Henry's Lake | 18-IC-08 | Unoccupied | 0 | 0 | |
| St. Spgs-Tar. Cr. | 18-IC-09 | Active, Successful | 1 | 0 | New alternate nest |
| Hale Canyon | 18-IC-10 | Active, Successful | 1 | 1 | |
| Moonshine | 18-IC-11 | Unoccupied | 0 | 0 | |
| Last Chance | 18-IC-12 | Active, Successful | 2 | 0 | |
| IP Bills | 18-IC-13 | Occupied, Inactive | 0 | 0 | |
| Flat Rock | 18-IC-14 | Active, Successful | 2 | 0 | |
| Riverside | 18-IC-15 | Active, Successful | 1 | 1 | |
| Snake River Butte | 18-IC-16 | Active, Successful | 1 | 1 | |
| Buffalo River | 18-IC-17 | Occupied, Inactive | 0 | 0 | |
| Big Bend | 18-IC-18 | Active, Unsuccessful | 0 | 0 | New territory. Blowdown killed 2 advanced young. |

**Summary Statistics:**
Total number nesting territories: 42
Number occupied territories: 39
Number active territories: 29
Number successful territories: 22
Number advanced young: 39

Advanced young/occupied nest: 1.00

Advanced young/active nest: 1.34

Advanced young/successful nest: 1.77

## Historic Bald Eagle Productivity: Habitat and Environmental Effects

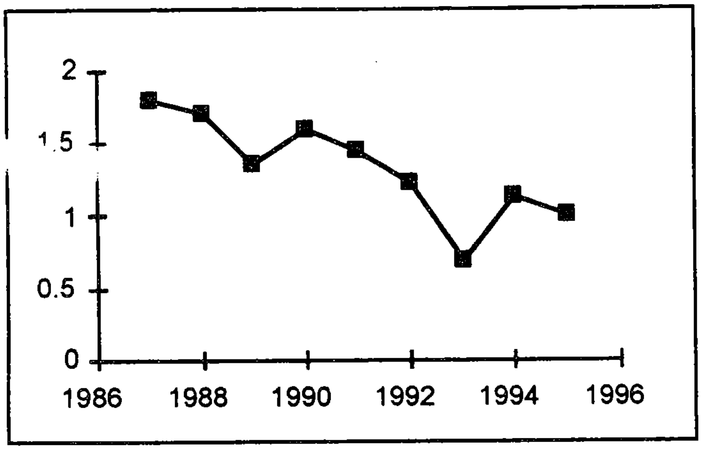
We are attempting a general evaluation of bald eagle productivity in Southeast Idaho over the past decade as a baseline for comments on future habitat management concerns. Although it can be fairly stated that the many factors which influence bald eagle productivity make this analysis difficult (e.g. Fraser et al. 1985), it is timely to summarize current knowledge in order to isolate and manage those factors that can be controlled. Parameters which might govern bald eagle productivity and which are beyond our control, at least in the short-term, include food availability in critical periods, annual precipitation, weather severity and related factors, availability of suitable nest sites, and individual factors such as pair experience and levels of intraspecific agonism. We are attempting the difficult task of analyzing such parameters to clarify our analysis of factors that managers can control, such as levels of human activity in key areas. Our complete analysis of Southeast Idaho productivity will appear in the 1996 productivity report. We begin here with a general look at productivity trends over the period.

Since 1987, productivity monitoring in this region has been intensive enough to suggest that almost all nesting areas were accounted for each year. Table and figure provide a sense of productivity trends over this period. The number of nesting areas and total number of young produced has increased dramatically, whereas the per pair productivity rate appears to have declined. The Greater Yellowstone nesting population has experienced exponential growth over the past two decades, with some indication that the population is approaching habitat saturation (Swenson et al. 1986, Harmata and Oakleaf 1992).

**Table 4. Bald eagle productivity at nesting areas in East Idaho, the Idaho portion of the Greater Yellowstone Ecosystem, 1987-1995.**

| Year | Advanced young/occupied nest (productivity known) |
|---|---|
| 1987 | 1.80 (n = 20) |
| 1988 | 1.70 (n = 23) |
| 1989 | 1.35 (n = 26) |
| 1990 | 1.59 (n = 27) |
| 1991 | 1.45 (n = 31) |
| 1992 | 1.23 (n = 35) |
| 1993 | 0.69 (n = 35) |
| 1994 | 1.13 (n = 38) |
| 1995 | 1.00 (n = 39) |

**Figure 2. Trend in bald eagle productivity at nesting areas in East Idaho, the Idaho portion of the Greater Yellowstone Ecosystem, 1987-1995.**




Below we discuss habitat and environmental parameters as a frame for our ongoing analysis of bald eagle productivity. We discuss generally effects on prey availability, weather, individual pair behavior, and human activity.

Prey availability. Bald eagles in stable populations are thought to be food limited (Sherrod et al. 1977, Stalmaster and Gessaman 1982). Factors which reduce prey availability during critical periods of the nesting cycle can cause reduced productivity. Major environmental factors which influence prey availability include annual precipitation and weather severity. In part because river systems in this area are controlled by storage dams, annual precipitation, most importantly winter snowfall, determines stream flow, water level and fluctuation frequency in reservoirs. Winter weather severity determines the degree of river icing (which is strongly influenced by stream flow), and thus, fish availability at critical periods. Weather severity also influences the availability of other potential prey such as waterfowl, small mammals, and ungulate carrion.

Most raptor breeding failures occur early in the cycle, as females either do not lay eggs, abandon their eggs, or young die soon after incubation (Newton 1979). Brown (1976) recognized two critical periods during the nesting cycle, the pre-laying/egg laying period and the early nesting period immediately after hatching. In the first of these two periods, breeding females need extra food to lay down reserves of body fat and protein for egg laying and subsequent incubation and brooding; females which do not accumulate reserves do not lay (Newton 1979). Although bald eagle egg weights are a small percentage of adult weight (average of 3% of adult female weight, Stalmaster 1987), females face the rigors of approximately 32-35 days of incubation, followed by intensive brooding of young nestlings for approximately 3 weeks. Female condition at time of egg laying is thus a factor in productivity when food sources are particularly critical.

The second stressful period comes immediately after hatching when the young eaglets grow rapidly in size and food requirements and the brooding female still requires food from the male. If prey availability is limited in this period, the male may simply not be able to provide sufficient food. Adult attentiveness at the nest could thus decline at a critical period when adults are food stressed, and nestling fratricide (Stalmaster 1987) may occur.

Weather during the nesting period affects both bald eagle energy needs and prey availability. Newton (1979) cited examples of decreased productivity and delayed egg laying during cold, wet springs in several raptorial species. In tests with captive bald eagles, Stalmaster (1983) found that bald eagle daily energy consumption increases at approximately 4.8 kcal. for each degree C decrease in temperature below ambient air temperatures of 10.6 degrees C. Thus extreme cold and/or windy weather during pre-laying could reduce female body condition, and influence the energy needs of brooding females and young immediately post-hatching.

From 1988 to 1992, we closely monitored 6 nesting areas to determine the level of young nestling mortality. In these 30 observed nesting attempts (6 areas over 5 years), two nest blowdowns resulted in losses of entire clutches within two weeks of hatching, and two clutches at Dry Canyon never hatched despite over 60 days of incubation. In the remaining 26 observations, partial clutch mortality, the death of 1 of 2 hatchlings produced, occurred on at least 3 occasions (11.5% of observations). One brood of two nestlings died of unknown cause on the nest when about 2 weeks old. Three incidental observations of partial clutch mortalities were noted at other sites. Nestlings beyond about three weeks of age rarely died. All advanced nestling mortalities in our observations over 16 years were due to nest blowdowns.

During the cold and wet springs of 1993 and 1995, most of the pairs which nested in higher elevations of this study area did not successfully raise young, even though nesting areas were occupied. In approximately 27 unsuccessful nesting attempts at higher elevations on Palisades Reservoir and in Island Park over these two years, only one failed attempt produced young that survived to advanced age. These 8-week old nestlings were killed in a nest blowdown. In all the other unsuccessful attempts, the pairs either failed to produce eggs, did not hatch eggs, or nestlings died soon after hatching.

<u>Direct weather effects.</u> Prolonged or intensive wet, cold periods or extreme heat during critical periods can also cause direct mortality of young nestlings. The age at which bald eagle young can thermoregulate is at about 3 weeks, if the weather is not too severe (Stalmaster 1987). Locally, critical periods for nesting pairs vary by elevation. At lower elevation sites, bald eagle pairs initiate nesting activity in February, and begin to incubate in early to mid-March. Thus, the young eagles at lower elevation sites are particularly vulnerable to severe weather in April. At higher elevations around Palisades Reservoir and in Island Park, the nesting chronology is up to one month later than at the earliest sites on the South Fork. May is thus a critical period for young nestlings at these higher elevations.

Harmata and Oakleaf (1992) developed a weather severity index for bald eagle nesting after a similar index developed for elk in Montana (Picton 1971). This index relies primarily on mean daily temperature and depth of snow cover on the ground, and does have predictive value for the larger differences in local climate as were detected between geographic areas in lower and higher elevations.

We are attempting to detect the effects of weather differences among years at individual nest sites. We are examining the use of daily minimum air temperature in our calculations of weather severity because during the winter and early spring months under consideration, bald eagles spend upwards of 60% of the 24-hour day under low light conditions when temperatures are usually at their lowest. This temperature also seems a more realistic perspective of temperature extremes than an average, which might mask extreme night-time temperature drops. We are also examining daily precipitation with the assumption that individual precipitation events at nest sites may affect productivity. Broad annual weather effects, such as cold, wet springs, may affect many nesting areas. Individual weather events also occur, such as the windthrows of nests at Pine Creek in 1987, Gormer Canyon in 1988, Antelope Creek in 1992, Cress Creek in 1993, and Big Bend in 1995. Localized micro-bursts can destroy even well-built nests in stable nest trees, although wind is more often a factor when the supporting structure is suspect.

Experience of the nesting pair. In their first year of active nesting, many inexperienced bald eagle pairs fail to raise young. In our records, 7 of 17 certain first attempts between 1983 and 1995 resulted in no young produced. Poor nest construction or nest site selection and inattentiveness were thought to be causes. (Ten other newly discovered nests in this period were not included in the analysis because there was good evidence that these nests had been established at least one year prior to their discovery.) Usually nests that failed were abandoned early in the nesting season, whereas in 1 case, Big Bend, a fragile nest structure blew down and killed advanced young near fledging age. Mean productivity for the 17 new pair attempts was .882 young/nesting attempt (s.d. = .857). Mean productivity in 279 attempts by experienced pairs in comparable years (eliminated two extreme weather years) was 1.301 young/nesting attempt (s.d. = .923), intuitively a rather large difference, but statistically insignificant because of high variability in individual nesting success.

Territorial interactions. As numbers of nesting bald eagle pairs increase, it may be expected that competition for resources will also increase and average productivity decline. Increased territorial aggression would also contribute to a productivity decline. An example of this effect to date may be the Pine Creek bald eagle pair. This pair still occupies its traditional nesting area, but in the two seasons since arrival of the Five Ways nesting pair within what was documented by radio telemetry as a favored foraging area for the Pine Creek pair in prior years, the Pine Creek pair has not been productive. Previously, the Pine Creek pair produced young in every year since establishment in 1977, except 1982 (adjacent Dry Canyon territory established) and 1987 (nest blowdown).

Human activity effects. Humans have had dramatic effects upon bald eagle populations generally across their historic range (Lincer et al. 1979) and specifically within the Greater Yellowstone area (Swenson et al. 1986). Shooting, trapping, and predator control activities contributed to the decline of bald eagles at and beyond settlement, and DDT use led to dramatic declines in the mid-part of the century (Broley 1958, Lincer et al. 1979).

Shooting and other direct human-induced mortality still remove bald eagles, and environmental pollutants may impose limitations that are as yet undetermined (Harmata and Oakleaf 1992). However today, human activities of an indirect affect may present even greater and longer-term threats. Activities which result in permanent loss of bald eagle habitat, such as second home development, are increasingly evident within the Greater Yellowstone area, and activities such as dispersed recreation, which result in temporary disruption of eagle activities, have increased dramatically in recent years (Whitfield 1993).

Early management efforts were focused around protection of nest sites. Grubb (1980) found that nests closer to human activity were less productive than nests farther from human activity. However, Fraser et al. (1985) suggested that association of reduced productivity with human activity is difficult because of the multitude of factors which influence productivity. Fraser et al. (1985) did find that nests built on developed shorelines were farther from water than nests build on undeveloped shoreline. More recent studies examined the influence of human activity on use of foraging areas (e.g. McCarigal et al. 1991). Research in Greater Yellowstone has noted that adults focus their foraging activity early and late in the day, and thus avoid human activities that occur more in middle of day (Harmata and Oakleaf 1992, Whitfield 1993) is this avoidance of humans by eagles or merely response to needs early in day. In our observations in late winter-early spring, eagle foraging activity occurs throughout the day. Thus there is an apparent shift in temporal activity after fishing season opens. However, a further complication is the influence of daytime temperature differences between these seasons. Observed bald eagles do appear to avoid activity in hot periods.

In our analysis, after isolating the influences of parameters such as weather, we will attempt to compare productivity among areas classified by broad categories of human activity, to include:

(1) New industrial or residential development within nesting areas.

(2) Loud humans on the ground within nesting area in critical periods in activities such as dispersed recreation that are unpredictable.

(3) Loud humans on the ground within the nesting area in critical periods, but in activities that are predictable, such as farming of established fields or strongly focused recreation with limited accessibility to critical areas.

(4) Low levels of use of nesting areas, but high levels of human activity in primary foraging areas.

(5) Human activity level low within nesting areas and principal foraging areas.

**Problem Areas**

One motivation for detailed analysis of productivity effects is the observed decline in productivity at key nesting areas, problem areas. Several bald eagle breeding areas with long, productive histories have not been detectably productive in recent years. Our assessment of the situation in these areas is that these pairs are no longer producing young because of greatly increased summer home development and recreational activity. Other breeding areas, though still productive in 1995, have been extensively altered by human development in recent years, with the prospect that breeding pairs will be forced to relocate to new primary nesting sites within their home ranges, if available, or fail to produce young.

Henry's Lake is the oldest known bald eagle breeding area in Eastern Idaho, with eagles first documented at this site in the 1930s. Between 1976 and 1992, 29 young bald eagles were fledged from nests in this breeding area. However, in 1993-95, we have not observed nesting attempts in the known nesting area. Two adults occupied the known primary nesting area in 1993 and 1994, but none were seen in 1995. Growth in a summer home subdivision near the known nests, and a great increase in year-round human use of the primary nest area, may be the cause of this formerly productive site being unproductive in the last three years. During